PHYTOTOXICOLOGY ASSESSMENT SURVEY INVESTIGATION IN THE VICINITY OF GENERAL CHEMICAL CANADA LIMITED, AMHERSTBURG - 1986

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Environment Ontario

Jim Bradley
Minister

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Phytotoxicology Assessment Survey Investigation in the Vicinity of General Chemical Canada Limited, Amherstburg - 1986

Report prepared by:
George N. Vasiloff

Phytotoxicology Section
Air Resources Branch

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Summary

Since 1919, soda ash has been produced commercially at the Amherstburg site which, since 1986, has been operated by General Chemical Canada Limited. Ownership of the genetron and hydrofluoric acid manufacturing plants which have been operating at the same site since 1970, was retained by Allied Chemical Canada Limited.

For many years, the Ministry of the Environment has maintained an annual vegetation surveillance program in order to monitor the presence and severity of visual injury and chemical content of sampled silver maple foliage.

In general, the severity of injury induced by industrial pollutants on the 1986 vegetation was somewhat reduced from that observed in 1985 - particularly during the early summer months. When the monthly injury ratings within the survey area over the entire 6 year period were compared with corresponding chemical analysis results, there was an indication that sodium, chloride and fluoride all may be involved as causal factors in the injury complex. However, it cannot be determined with any degree of certainty whether the salt and/or fluoride elements - singly or in combination - induced the injury.

In 1986, the monthly and seasonal mean survey area sodium values were lowest since 1981. In spite of the lower 1986 average, the survey area sodium averages were still 2-3 times higher than corresponding control collections. The Phytotoxicology upper limit of normal guideline was also exceeded on 6 occasions at four survey sites in 1986.

Chloride values in the 1986 vegetation were virtually unchanged from the previous years and were only marginally greater than control values at several sites. On the basis of these findings, the role of General Chemical as a source of chlorides is not clear.

Seasonal mean calcium values from 1981 to 1986 have remained relatively similar and approximated values found in the control vegetation.

Fourteen complaints of vegetation injury were received and investigated in 1986 but only one was associated with salt emissions from General Chemical. In 1985, 8 of 12 complaints were linked with salt emissions from General Chemical and possibly fluorides from Allied Chemical.

1.0 Introduction

Commercial production of soda ash at the present General Chemical Canada site began initially in 1919 with a modest output of 40,000 tons. Since that time, production facilities have been expanded and new product lines such as calcium chloride have been added. In 1970, Genetron (a cooling gas, aerosol propellant and foaming agent) and hydrofluoric acid manufacturing plants were constructed on the site.

Compared with the early days, the extent of the operations at the General Chemical site today is very large. In total, the plant, quarries and other properties occupy more than 500 acres in the Amherstburg area. Current output of soda ash is in the neighbourhood of 400,000 tons annually.

For many years, Allied Chemical Canada Limited owned and operated the soda ash and related products facilities, as well as the Genetron and hydrofluoric acid plants. In 1986, General Chemical Canada Limited assumed control of the soda ash and related product operations. The Genetron and HF plants were retained by Allied Chemical Canada Limited.

Since the early 1970s, the Phytotoxicology Section has maintained a continuing program of surveillance to monitor the severity of visual injury and to determine the chemical content of sampled vegetation. Each year at 10 established survey locations near the General Chemical plant silver or Manitoba maple foliage has been collected at month's end from May to September.

In addition, Phytotoxicology representatives have responded to complaints of vegetation injury from private citizens living near the General Chemical plant.

2.0 Reports of Breakdowns or Production Upsets

Events during production which result in the abnormal release of emissions from the General Chemical operation are customarily reported to Ministry of the Environment officials in the Windsor office. In 1986, the company reported the release of a minor amount of ammonia from the soda ash plant during a planned power outage to check an electrical generator. Subsequent to the check, there was, apparently, a delay in the plant start-up because of vapour locks. As a result, an unknown quantity of ammonia gas was released and blown in westerly and northwesterly directions. The Phytotoxicology Section did not receive any complaints of vegetation injury from residents with properties impacted by the release.

3.0 Monthly Silver Maple Surveillance Visits

3.1 Visual Evaluation of Maple Foliage

The month-end Phytotoxicology surveillance of foliage has taken place at the 8 established sites located around the Allied and General Chemical plants (Figure 1). Each year, at the end of each month from May to September, maple foliage has been visually examined for symptom evidence of air pollution injury and then sampled for chemical analysis. Because of unavailibility of silver maple at sites 33 and 50, Manitoba maple foliage was substituted. However, because of species differences, the data for Manitoba maple have not been utilized in the assessment of chemical and visual trends. Data from the Manitoba maple control site (50) have similarly not been included. Surveillance visit dates in 1986 and the names of Phytotoxicology investigators appear in Table 1.

During each of the 5 month-end surveillance visits in 1986, a complete visual examination of maple foliage at each of the 8 silver maple survey sites was conducted. Any injury symptomatology considered to be industrially induced was assigned an average rating based on a universal scale used by the Phytotoxicology Section.

Because of the close physical proximity of General Chemical to Allied Chemical and the nature of product lines, the likelihood of both salt-related emissions from General Chemical and fluoride emissions from Allied Chemical impacting on vegetation at Phytotoxicology surveillance sites is possible. Because the symptom expression of combined salt and fluoride emissions on vegetation is virtually identical, no attempt has been made since 1982, to differentiate between the two possible pollutants. Disorders attributed to insects, disease or of a physiological nature are routinely excluded from injury assessments. All 1986 visual injury evaluations of silver maple foliage have been assembled in Tables 2-6. For comparative purposes, evaluations for the years 1981 to 1985 have been included in the tables. Control site evaluations (12) do not appear.

On the first visit to the area in May of 1986, trace levels of industrially-induced injury were observed on the terminal portions of some silver maple foliage at Site 29. No injury was observed at any of the other survey locations (Table 2).

At the end of June, trace levels of terminal injury were again found at Site 29. Compared to the June evaluations of 1985 at the same locations, the 1986 injury levels were lower (Table 3).

In July, trace levels of industrially-induced injury were observed at 4 survey sites (16, 29, 31 and 1). With the exception of Sites 29 and 30, no change in injury severity was noted from July of the previous year (Table 4).

Injury ratings at the end of August, 1986 (Table 5) showed some decline from those of the previous year at 5 of 8 sites.

The final evaluation of silver maple foliage for the 1986 growing season was conducted at the end of September. Comparative evaluations in Table 6 show that industrially induced foliar injury at the end of the 1986 growing season was slightly less severe than that observed in 1985 and in previous years.

The practice of collecting and preserving representative samples of injured maple foliage from surveillance locations was continued in 1986. This collection of injured foliar specimens is intended to provide a historical perspective of injury severity and symptom expression.

3.2 Visual Injury Ratings : Chemical Content Relationships

Visual injury values for 7 survey sites (control Site 12 excluded) during each of the 5 monthly surveillance occasions were compared with sodium, chloride and fluoride values of the evaluated foliage. In this manner, visual injury ratings : chemical content relationships could be examined for individual or a combination of elements. Results of the statistical comparisons (correlation coeffiecient/probabilities) have been assembled in Table 7.

On the basis of the monthly relationships between foliar injury and chemical concentration over this 6 year period, it is apparent that all of the 3 potentially phytotoxic contaminants (sodium, chloride and fluoride) are associated with foliar injury in the survey area. When the data are treated as multiple or co-contaminants, it is also apparent that the relationships with injury severity are even stronger, further confirming the joint and possibly interactive role of each in the injury complex.

Because of the subjective nature of the assessment of injury severity, the skewed percentage scale (injury rating system) and the fact that the ratings have been performed by different staff over this 6 year period, this statistical comparison can be interpreted only as an indication of chemical involvement and should not be mathematically refined to determine a causal role for any one contaminant or to predict injury severity at any one station or year.

3.3 Silver Maple Foliage Collection

Following the observational aspect of each month-end visit to each of the 8 surveillance sites, true triplicate samples of silver maple foliage were collected for chemical analysis from the side of each sample tree facing the General Chemical plant. At each location, a single sample of foliage was obtained by representatives of General Chemical for independent analysis. During the collection process, Phytotoxicology personnel wore plastic gloves in order not to contaminate the sampled foliar material.

Each individual Phytotoxicology sample was collected and stored in a clean, new plastic bag with clear identification markings. All samples were returned to the Toronto laboratory for processing

according to a standardized not-washed method. All processed samples were then oven-dried and ground in a Wiley mill.

Completed, processed samples were submitted to the Ministry's Inorganic Trace Contaminants Section laboratory for analysis to determine sodium, chloride and calcium concentrations in the leaf material.

4.0 CHEMICAL ANALYSIS RESULTS

4.1 Sodium

Sodium values in not-washed silver maple foliage for each of the 5 month-end surveillance visits near the General Chemical complex in 1986 appear in Table 8. Although triplicate samples were individually collected and analyzed, each sodium value in the table represents the average of the set of triplicates. For reference purposes, the Phytotoxicology upper limit of normal guideline for sodium in not-washed urban vegetation has been included in the table. Values in the table which exceeded the guideline have been underlined.

The table shows that six sodium values were in excess of the Phytotoxicology guideline in 1986. Two were recorded in June at Sites 31 and 1, another two in July at Sites 16 and 1 and one each in August (Site 18) and September (Site 31). Seasonal mean values for each site were highest at Site 31 followed by 1, 16 and 18. The seasonal mean at Site 31 exceeded the Phytotoxicology guideline of 350 ppm. Based on the similarity of monthly all-site values no pattern of seasonal deposition was evident.

Comparative survey area (all-site) and control site monthly and seasonal mean values for the period from 1981 to 1986 have been compiled in Table 9. Seasonal mean values shown at the base of the table indicate that survey area means from the high of 623 ppm in 1984 have dropped significantly to a six year low of 224 ppm in 1986. These data appear in graphic form in Figure 2.

The average monthly mean sodium values for 1981 to 1986, shown at the right of the table, clearly indicate that levels of the element were greater in the survey area vegetation than in similar samples from the control site. The monthly mean values are shown graphically in Figure 3. The figure also shows that sodium deposition appeared greater at the beginning and end of the 5 month sampling period. A similar, albeit much less pronounced seasonal pattern also was detected in control area samples.

Sodium Summary

Six exceedences of the Phytotoxicology sodium guideline were recorded in monthly samples of not-washed silver maple foliage in 1986. The distribution of monthly exceedences according to site location from 1981 to 1986 has been compiled in Table 10. The data show that the greatest number of exceedences occurred in September

with 17, followed by 14 for May. Sites 31, 16 and 1 recorded the highest number of exceedences with 23, 14 and 11, respectively.

Based on seasonal and directional considerations, it can be concluded that, from 1981 to 1986, sodium values in survey maple foliage were greater during the early and late summer periods and that higher values were found at sites located to the north and south of the General Chemical plant.

4.2 Chloride

Values of the element found in not-washed silver maple foliage for each of the 5-monthly sample periods in 1986 from May to September appear in Table 11. Because the upper limit of normal guideline for chloride is currently under re-evaluation, values of the element found in the General Chemical surveillance vegetation have been compared with the values from the control site in order to determine the degree of chloride contamination. Within the survey area (all sites), monthly values from May to September show very little variation but in most cases are slightly greater than their respective controls. At individual sites, seasonal mean values were greatest at Sites 16, 18 and 29, to the south, southwest and northwest, respectively.

In Table 12, monthly and seasonal mean chloride values found in the not-washed silver maple foliage from 1981 to 1986 have been assembled and reveal that site values have remained relatively constant over the 6 year period (Figure 4).

Survey area (all-site) monthly mean values from 1981 to 1986 indicate that values of chloride tend to increase from May to September. Control site mean values, however, also escalated during the same period. In relative terms, the net chloride values from May to September during the six year period appear similar (Figure 5).

4.3 Chloride Summary

Although there has been some variation in seasonal mean chloride values in silver maple foliage within the survey area since 1981, generally, values have been elevated relative to those from the control site. A major portion of this elevation appears to have resulted from elevated levels at 3 sites to the S, SW and NW. This casts some uncertainty as to a source contribution, given the upwind location (relative to General Chemical) of these sites and the lack of fit with the sodium and fluoride contamination pattern.

4.4 Calcium

Monthly calcium values found in not-washed silver maple foliage at 8 surveillance sites in 1986 appear in Table 13. Because an urban upper limit of normal guideline is not available for this element, values found in the survey vegetation are compared with those

from control sites in order to determine possible source effects. As both the all-site monthly mean values and control site values escalated from May to September, and as differences between the two were relatively minor, it is apparent that no widespread pattern of contaminant deposition was present within the survey area.

All-site monthly and seasonal mean calcium values found in not-washed silver maple from 1981 to 1986 appear in Table 14. Again, all-site seasonal mean values from each of the six years are very similar to each other and their respective controls. These similarities have been demonstrated in graphic form in Figure 6.

Average monthly mean survey area (all-site) values for each of the 5 monthly sample periods from 1981 to 1986 also appear in Table 14. Both survey area and control site values increased as the season progressed with mean calcium values being greater in September than in May. These data appear as bar graphs in Figure 7.

4.5 Calcium Summary

Seasonal mean calcium values throughout the survey area from 1981 to 1986 have remained relatively static and have closely approximated values found in the control vegetation. Based on the similarity of survey area and control site values, calcium emissions from the General Chemical plant do not appear to be causing detectable vegetation contamination.

5.0 Annual Comprehensive Vegetation Sampling Survey

The vegetation surveillance program conducted at the 8 established sites provides an indication of emission effects close to the General Chemical plant. In order to determine the influence of emissions from the plant over a larger area, however, the Ministry has conducted one annual maple foliage surveillance at an additional 20 outlying locations (Figure 1). At each site in 1986, maple foliage was examined for evidence of industrially-induced injury and then sampled in triplicate for chemical analysis.

Based on the visual assessment results of maple foliage examined at each of the 20 additional outlying surveillance sites, virtually no injury attributable to emissions from the General Chemical operation was present. Chemical analysis of the sampled vegetation has been completed and the 1986 results, along with those from 1981 to 1985, will be reported soon.

6.0 Complaint Investigations

The Phytotoxicology Section investigated a total of 14 complaints in 1986 from private citizens with properties located relatively close to the General Chemical plant.

Only one complaint of injury was documented as a salt-related

effect from General Chemical. This complaint was from a resident on nearby Texas Road who was concerned about injury to a number of small white spruce trees located at the rear of the property. Chemical analysis results of injured material facing General Chemical contained significantly higher sodium values than healthy needles facing away. The report outlining the findings of this investigation has been issued to both the complainant and the company. None of the vegetation injury at the remaining 13 complainant properties was attributed to industrial emissions.

7.0 Conclusions

The objectives of the Phytotoxicology surveillance visits in the vicinity of General Chemical are to determine the impact of possible emissions from the plant on nearby vegetation. These objectives are achieved through the visual examination of foliage for idustrially-induced injury symptoms and the chemical analysis of sampled vegetation.

Visual evaluations of injury to the 1986 vegetation were compared to those of previous years. The severity of injury induced by industrial pollutants on the 1986 vegetation was somewhat reduced from that observed in 1985 - particularly during the early months of the summer. Although visual injury ratings of greater severity correlated fairly well with increased sodium, chloride and fluoride values in the analyzed vegetation, it cannot be determined with any degree of certainty whether the salt and/or the fluoride elements - singly or in combination - induced the injury.

From a chemical content standpoint, there was a decrease in the mean monthly all-station values of sodium in the 1986 vegetation compared to those of 1985 and previous years. However, the 1986 survey area values were still 2-3 times higher than corresponding control collections with six monthly samples exceeding the urban upper limit of normal guideline.

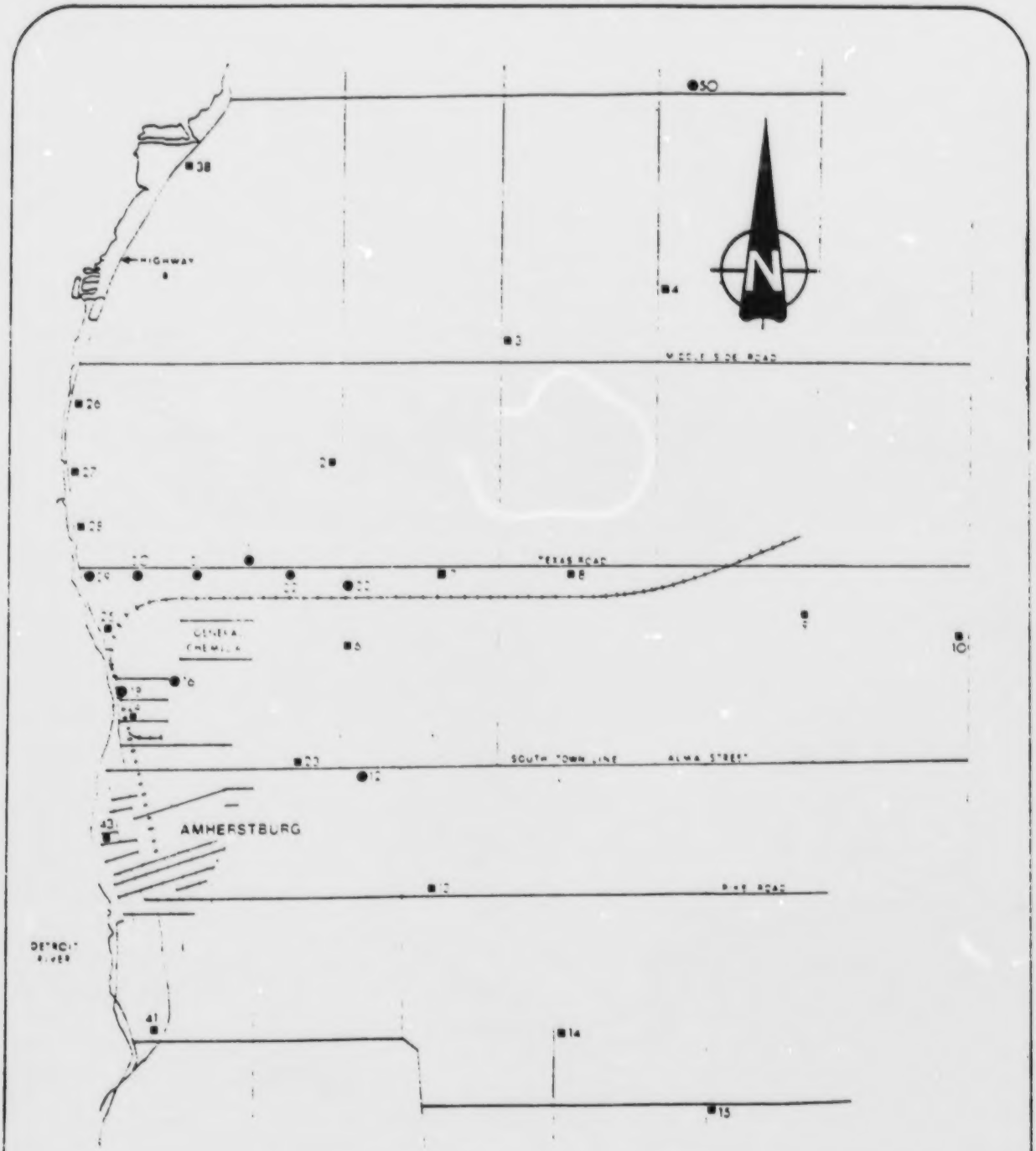
Little change was observed in the chloride values found in the 1986 maple foliage compared to previous years. Apart from a few site locations, levels of this element have been similar to control site values, casting some uncertainty as to a source contribution from the General Chemical plant.

With few exceptions, calcium values found in the 1986 vegetation approximated those of the control site. This pattern has varied little during this 6 year period.

Of 14 complaints of vegetation injury received and investigated by the Phytotoxicology Section, only one was associated with emissions from the General Chemical plant. This was down considerably from 1985, when 8 of 12 complaints were found to be associated with emissions from the General Chemical plant and possibly fluorides from the Allied Chemical plant.

FIGURE: 1 Locations of Phytotoxicology Maple Surveillance Sites in the Vicinity of General Chemical Canada Limited, Amherstburg

1986



● - Maple foliage sampled monthly from May to September at 10 sites.

■ - Maple foliage sampled on one annual occasion at 20 sites.

TABLE 1: Phytotoxicology Maple Foliage Surveillance Dates in the Vicinity of General Chemical Canada Limited

1986

Surveillance Date	Surveillance Vegetation	Phytotoxicology Investigators
May 28	Maple Foliage Inspection and Collection	G. Vasiloff & M. Mallette
July 2	Maple Foliage Inspection and Collection	G. Vasiloff & P. McGovern
August 1	Maple Foliage Inspection and Collection	G. Vasiloff & D. McLaughlin
September 4	Maple Foliage Inspection and Collection	G. Vasiloff
September 3 & 4	Maple Foliage Survey at 20 additional outlying sites (Inspection and Collection)	G. Vasiloff, W. Gizyn A. Kuja
October 2	Maple Foliage Inspection and Collection	G. Vasiloff

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TABLE 2: Visual Injury Ratings[1] of Air Pollution-Induced Symptoms on Silver Maple Foliage Collected during May in the Vicinity of General Chemical, Amherstburg[2]

1981 - 1986

Sample Station Number	Visual Injury Rating					
	1981	1982	1983	1984	1985	1986
16	Tr	0	Tr	Tr	Tr	0
18	Tr	Tr	Tr	Tr	0	0
29	0	Tr	Tr	Tr	Tr	Tr
30	0	Tr	Tr	Tr	Tr	0
31	Tr	Tr	Tr	S	Tr	0
1	Tr	Tr	Tr	Tr	Tr	0
32	-	-	0	Tr	Tr	0

0	-	0%
Trace	-	>0 - 1%
Light	-	2-10%
Moderate	-	11-35%
Severe	-	>35%

[1]Value represents total injury - no differentiation has been made between fluoride and/or salt symptomatology

[2]Control location 12 not included

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TABLE 3: Visual Injury Ratings[1] of Air Pollution-Induced Symptoms on Silver Maple Foliage Collected during June in the Vicinity of General Chemical, Amherstburg[2]

1981 - 1986

Sample Station Number	Visual Injury Rating					
	1981	1982	1983	1984	1985	1986
16	Tr	Tr	Tr	Tr	Tr	0
18	Tr	Tr	Tr	Tr	M	0
29	Tr	Tr	Tr	Tr	L	Tr
30	0	Tr	Tr	L	Tr	0
31	Tr	Tr	Tr	S	M	0
1	Tr	Tr	Tr	L	L	0
32	-	-	0	Tr	Tr	0

0	-	0%
Trace	-	>0 - 1%
Light	-	2 - 10%
Moderate	-	11 - 35%
Severe	-	>35%

[1]Value represents total injury - no differentiation has been made between fluoride and/or salt symptomatology

[2]Control location 12 not included

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TABLE 4: Visual Injury Ratings[1] of Air Pollution-Induced Symptoms on Silver Maple Foliage Collected during July in the Vicinity of General Chemical, Amherstburg[2]

1981 - 1986

Sample Station Number	Visual Injury Rating					
	1981	1982	1983	1984	1985	1986
16	L	L	Tr	Tr	Tr	Tr
18	L	Tr	Tr	Tr	0	0
29	L	Tr	Tr	Tr	0	Tr
30	Tr	L	Tr	Tr	Tr	0
31	M	L	Tr	L	Tr	Tr
1	L	Tr	Tr	M-S	Tr	Tr
32	-	-	Tr	-	0	0

0	-	0%
Trace	-	>0 - 1%
Light	-	2-10%
Moderate	-	11-35%
Severe	-	>35%

[1]Value represents total injury - no differentiation has been made between fluoride and/or salt symptomatology

[2]Control location 12 not included

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TABLE 5: Visual Injury Ratings[1] of Air Pollution-Induced Symptoms on Silver Maple Foliage Collected during August in the Vicinity of General Chemical, Amherstburg[2]

1981 - 1986

Sample Station Number	Visual Injury Rating					
	1981	1982	1983	1984	1985	1986
16	L	M	Tr	L	M	L
18	L	L	Tr	Tr	L	0
29	Tr	M	L	L	L	L
30	Tr	L	Tr	L	Tr	0
31	L-M	L	M	S	M	Tr
1	Tr-L	L	0	L-M	L	Tr
32	-	-	0	Tr	Tr	Tr

0	-	0%
Trace	-	>0 - 1%
Light	-	2 - 10%
Moderate	-	11 - 35%
Severe	-	>35%

[1]Value represents total injury - no differentiation has been made between fluoride and/or salt symptomatology

[2]Control location 12 not included

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TABLE 6: Visual Injury Ratings[1] of Air Pollution-Induced Symptoms on Silver Maple Foliage Collected during September in the Vicinity of General Chemical, Amherstburg[2]

1981 - 1986

Sample Station Number	Visual Injury Rating					
	1981	1982	1983	1984	1985	1986
16	L-M	M	Tr	L-M	L-M	M
18	Tr-L	L	Tr	Tr	Tr	Tr
29	Tr-L	M	L	Tr	Tr	0
30	Tr	L	0	L	Tr	0
31	L	M	L	S	L	L
1	Tr	L	Tr	L	Tr	0
32	0	Tr	Tr	Tr	Tr	Tr

0	-	0%
Trace	-	>0 - 1%
Light	-	2 - 10%
Moderate	-	11 - 35%
Severe	-	>35%

[1]Value represents total injury - no differentiation has been made between fluoride and/or salt symptomatology

[2]Control location 12 not included

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Table 7: Visual Injury: Chemical Concentration Relationships[a] - Silver Maple Foliage, 1981-86

Matrix of Correlation Coefficients

Single Element Correlations (r)			Multiple Element Correlations (r)			
Fluoride	Sodium	Chloride	Fluoride & Sodium	Fluoride & Chloride	Sodium & Chloride	Fluoride & Sodium & Chloride
0.39*	0.14^{NS}	0.47**	0.31^{NS}	0.52*	0.48*	0.55*
0.65**	0.39*	0.67**	0.66**	0.76**	0.68**	0.76**
0.40*	0.24^{NS}	0.66**	0.41*	0.66**	0.68**	0.68**
0.32^{NS}	0.78**	0.42*	0.78**	0.47*	0.78**	0.78**
0.31^{NS}	0.37*	0.43**	0.43*	0.46*	0.51*	0.51*
0.21^{NS}	0.01^{NS}	0.41*	0.22^{NS}	0.43*	0.43*	0.45 ^{NS}
0.25**	0.42**	0.51**	0.45**	0.52**	0.56**	0.56**

NS - Not significant

* - Significant at the 5% level ($p \leq 0.05$)

** - Significant at the 1% level ($p \leq 0.01$)

a - Monthly concentrations of the different contaminants utilized in single and multiple correlation comparisons with log-transformed (normalized) foliar injury ratings.

TABLE 8: Sodium Values[1] in Not-Washed Silver Maple Foliage in the Vicinity of General Chemical, Amherstburg

1986

Sample Site Number	Sample Period					SEASON MEAN
	May	June	July	August	September	
16	247	167	377	163	320	255
18	317	120	137	500	203	255
29	123	63	40	113	69	82
30	157	193	106	170	243	174
31	293	540	233	237	587	378
1	227	457	577	197	124	316
32	120	109	153	72	90	109
Mean (ALL SITES)	212	236	232	207	234	224
CONTROL	60	93	47	64	84	70

[1]Expressed as parts per million (ppm) - dry weight.

Phytotoxicology upper limit of normal guideline for sodium in not-washed urban foliage is 350 ppm.

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Table 9: Monthly Mean All-Site Sodium Values in Hot-Washed Silver Maple Foliage Collected in the Vicinity of General Chemical, Amherstburg

1981-1986

Sample Period	All-Site Mean Sodium Values - ppm - Dry Weight												AVERAGE MONTHLY MEAN	
	1981[1]		1982[1]		1983[1]		1984[2]		1985[2]		1986[2]			
	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site
May	630	160	522	70	711	110	477	120	385	88	212	60	490	101
June	560	80	224	67	392	50	590	90	326	64	236	93	388	74
July	295	217	287	37	242	63	522	91	247	55	232	47	304	85
August	514	80	569	47	411	97	745	81	245	70	207	64	449	73
September	598	125	573	265	513	93	779	183	464	65	234	84	527	136
SEASONAL MEAN ALL-SITES	519	132	435	97	454	83	623	113	333	68	224	70	432	94

[1]Silver maple not established at site 32

[2]Silver maple data from site 32 included

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TABLE 10: Number of Exceedences of the Phytotoxicology Sodium Guideline in Not-Washed Silver Maple Foliage Collected in the Vicinity of General Chemical, Amherstberg

1981 - 1986

Sample Site Number	Total Number of Exceedences: 1981-1986					SEASON TOTAL
	May	June	July	August	September	
16	4	1	3	2	4	14
18	2	1	0	1	1	5
29	0	0	0	0	1	1
30	1	0	1	1	2	5
31	4	5	3	5	6	23
1	3	3	2	1	2	11
32[1]	0	0	0	0	1	1
SITE TOTAL	14	10	9	10	17	60

[1]Data from this site available only from 1983 to 1986.

RE2109.10

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TABLE 11: Chloride Values[1] in Not-Washed Silver Maple Foliage in the Vicinity o
General Chemical, Amherstburg

1986

Sample Site Number	Sample Period					SEASON MEAN
	May	June	July	August	September	
16	0.4	0.4	0.5	0.6	0.5	0.5
18	0.3	0.4	0.4	0.7	0.6	0.5
29	0.2	0.2	0.5	0.7	0.2	0.4
30	0.1	0.1	0.1	0.1	0.2	0.1
31	0.2	0.3	0.2	0.3	0.4	0.3
1	0.2	0.3	0.2	0.3	0.3	0.3
32	0.1	0.1	0.1	0.1	0.1	0.1
Mean (ALL SITES)	0.2	0.3	0.3	0.4	0.3	0.3
CONTROL 12	0.1	0.1	0.2	0.2	0.3	0.2

[1]Expressed as percent (%) dry weight

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Table 12: Monthly Mean All-Site Chloride Values in Not-Washed Silver Maple Foliage Collected in the Vicinity of General Chemical, Amherstburg

1981-1986

Sample Period	All-Site Mean Chloride Values - percent Dry Weight												AVERAGE MONTHLY MEAN	
	1981[1]		1982[1]		1983[1]		1984[2]		1985[2]		1986[2]			
	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site
May	0.3	0.1	0.3	0.1	0.3	0.1	0.2	0.1	0.3	0.1	0.2	0.1	0.3	0.1
June	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.1
July	0.4	0.2	0.6	0.2	0.3	0.2	0.4	0.1	0.4	0.2	0.3	0.2	0.4	0.2
August	0.5	0.2	0.6	0.3	0.4	0.2	0.4	0.2	0.5	0.2	0.4	0.2	0.5	0.2
September	0.2	0.1	0.6	0.5	0.5	0.3	0.5	0.3	0.5	0.3	0.3	0.3	0.5	0.3
SEASONAL MEAN ALL-SITES	0.3	0.1	0.5	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.3	0.2	0.4	0.2

[1]Silver maple not established at Site 32

[2]Silver maple data from Site 32 included

RE2109.12

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TABLE 13: Calcium Values[1] in Not-Washed Silver Maple Foliage in the Vicinity of General Chemical, Amherstburg

1986

Sample Site Number	Sample Period					SEASON MEAN
	May	June	July	August	September	
16	0.98	1.53	1.57	1.57	1.93	1.52
18	0.76	1.05	1.30	1.93	2.97	1.42
29	0.69	1.27	1.00	1.43	0.84	1.05
30	0.60	0.84	0.97	1.11	1.40	0.98
31	0.91	1.13	1.07	1.57	1.63	1.26
1	0.64	1.13	0.93	0.92	1.04	0.93
32	0.62	1.03	1.10	1.20	1.87	1.16
Mean (ALL SITES)	0.74	1.14	1.13	1.39	1.54	1.19
CONTROL 12	0.71	1.19	1.16	1.40	1.73	1.24

[1]Expressed as percent (%) - dry weight

RE2109.13

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Table 14: Monthly Mean All-Site Calcium Values in Not-Washed Silver Maple Foliage Collected in the Vicinity of General Chemical, Amherstburg

1981-1986

Sample Period	All-Site Mean Calcium Values - percent Dry Weight												AVERAGE MONTHLY MEAN	
	1981[1]		1982[1]		1983[1]		1984[2]		1985[2]		1986[2]			
	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site	All Sites	Control Site
May	0.89	0.88	0.75	0.56	0.55	0.45	0.65	0.48	0.81	0.99	0.74	0.71	0.73	0.68
June	1.00	0.94	0.72	0.78	0.70	0.72	0.98	0.88	1.13	1.10	1.14	1.19	0.95	0.94
July	1.05	1.19	1.09	0.70	0.97	0.91	1.21	1.02	1.17	1.06	1.13	1.16	1.10	1.01
August	1.13	1.30	1.34	1.28	1.23	1.29	1.44	1.57	1.41	1.46	1.39	1.40	1.32	1.38
September	1.25	1.40	1.21	0.87	1.32	1.18	1.83	1.90	2.03	1.53	1.54	1.73	1.53	1.44
SEASONAL MEAN ALL-SITES	1.06	1.14	1.02	0.84	0.97	0.91	1.22	1.17	1.31	1.23	1.19	1.24	1.13	1.09

[1]Silver maple not established at site 32

[2]Silver maple data from site 32 included

RE2109.14

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Figure: 2

Seasonal Mean Sodium Values in Not-Washed Silver Maple

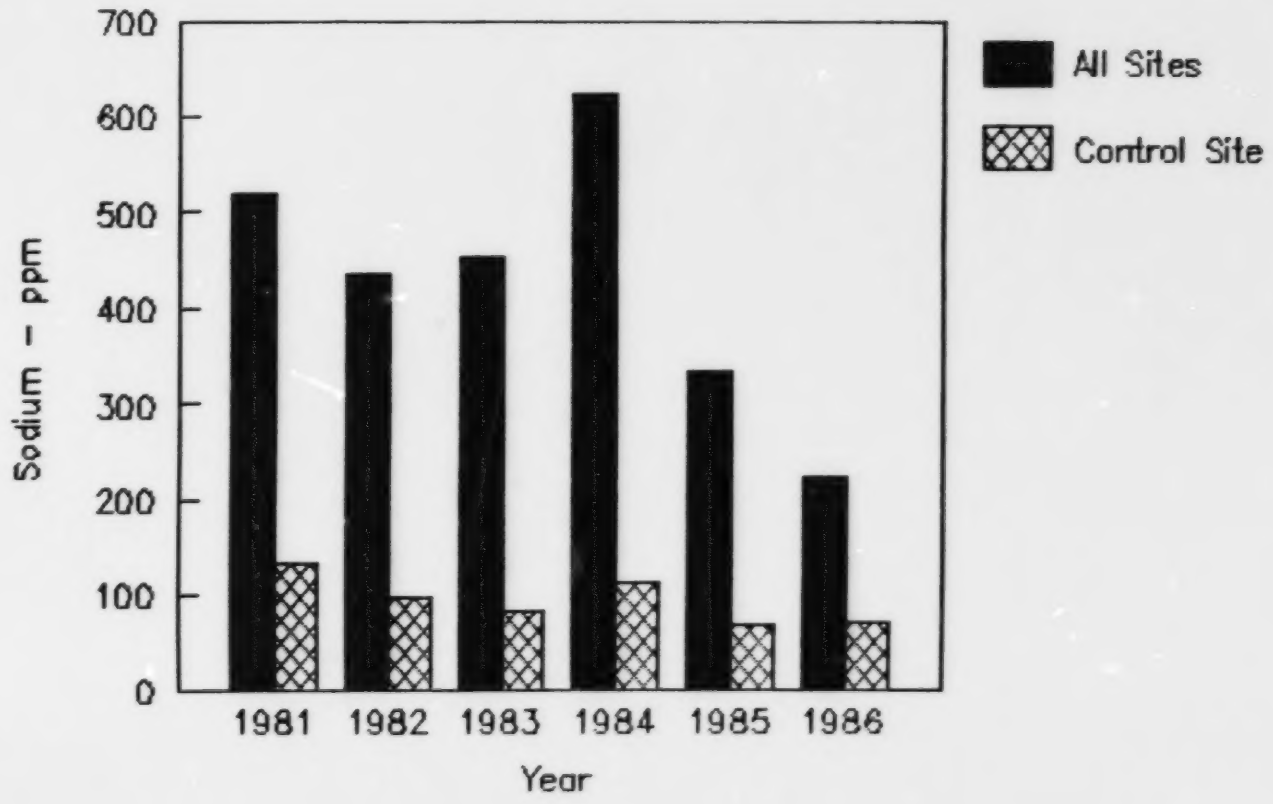


Figure: 3

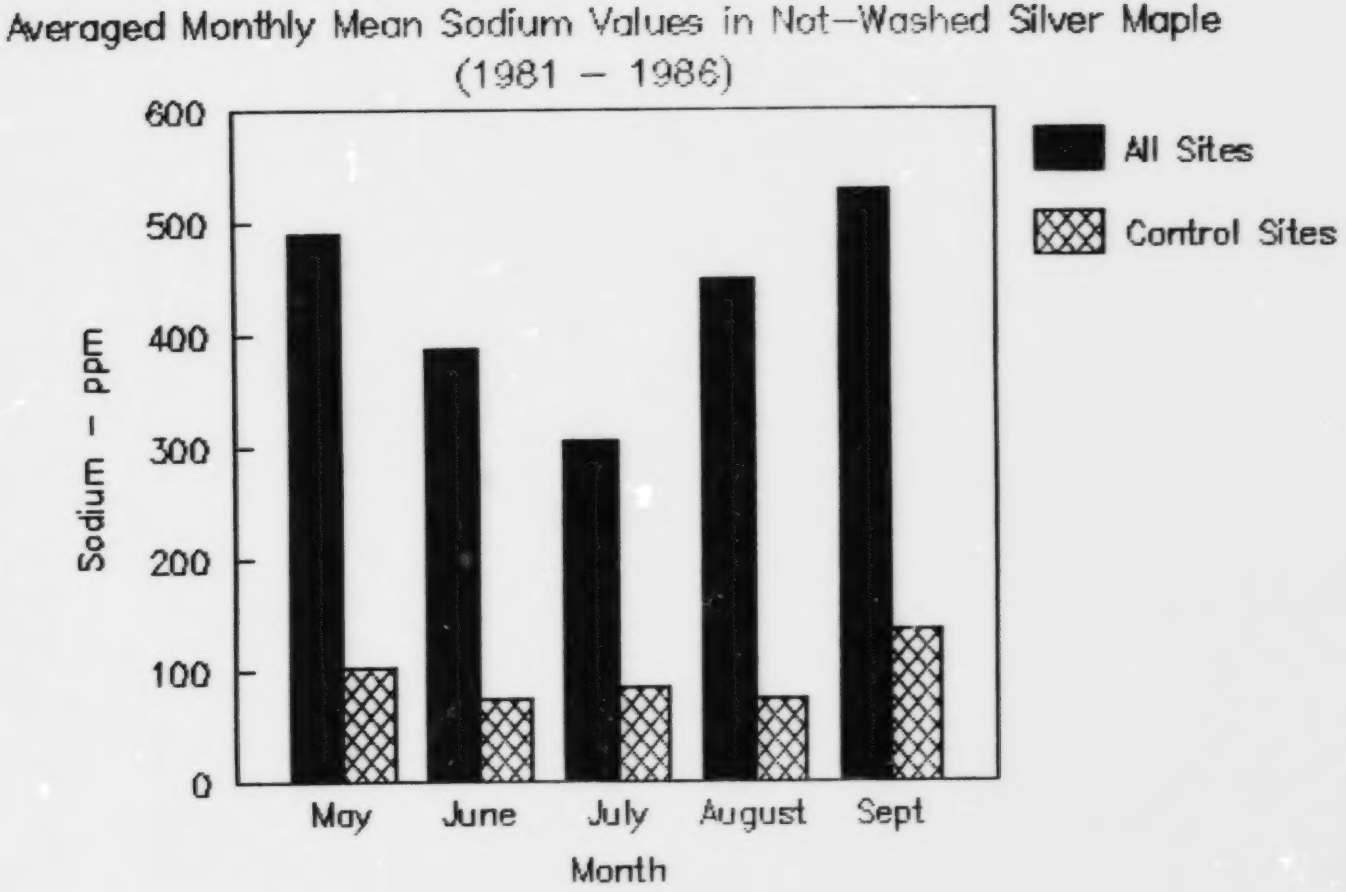

Averaged Monthly Mean Sodium Values in Not-Washed Silver Maple
(1981 - 1986)
600
500
400
300
200
100
0
Sodium - ppm
May
June
July
August
Sept
Month
All Sites
Control Sites

Figure: 4

Seasonal Mean Chloride Values in Not-Washed Silver Maple

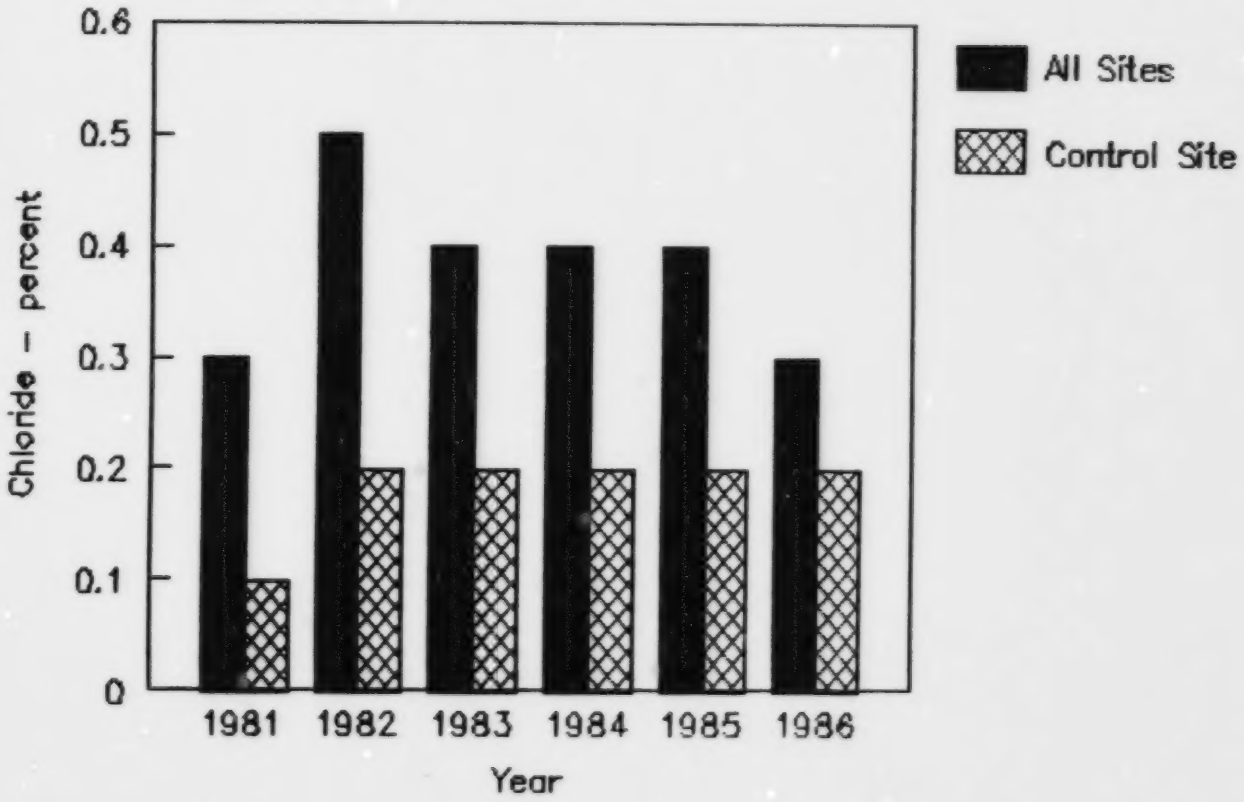


Figure: 5

Averaged Monthly Mean Chloride Values in Not-Washed Silver Maple

(1981 - 1986)

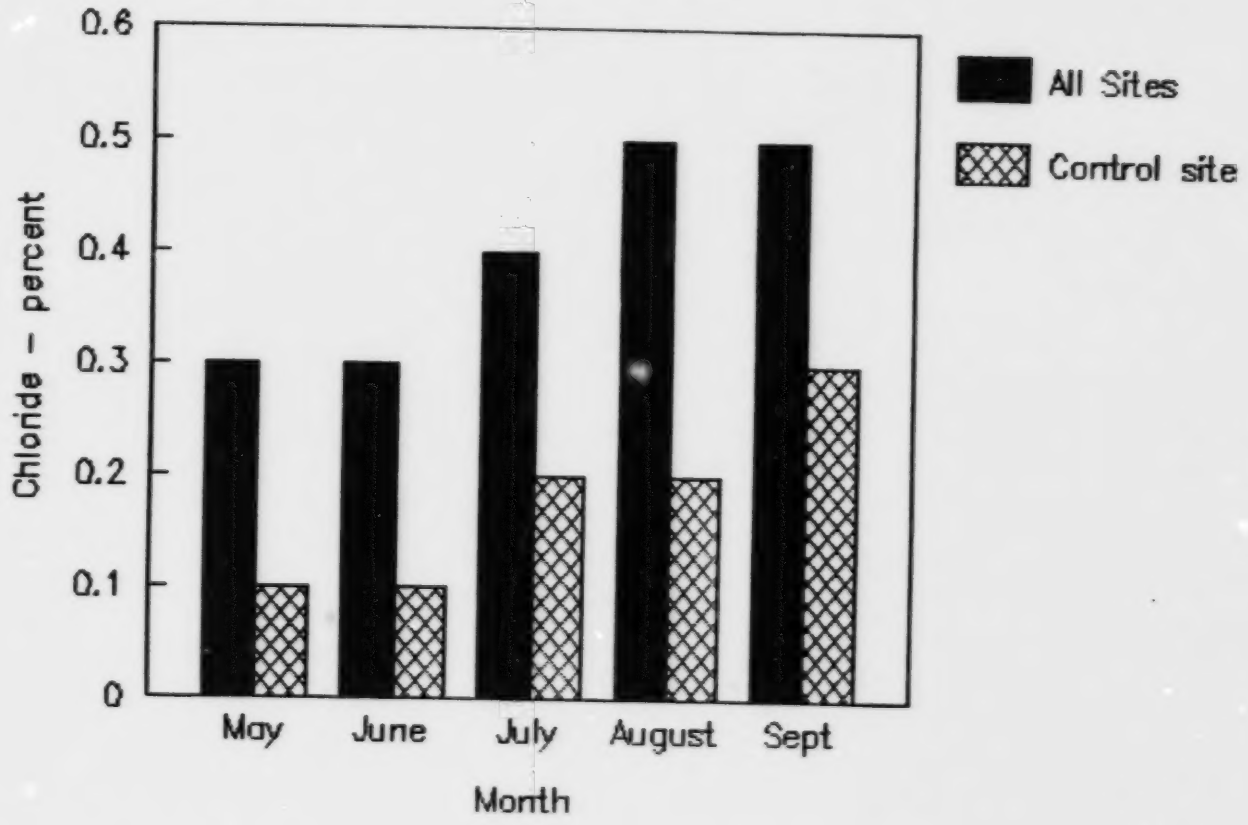


Figure: 6

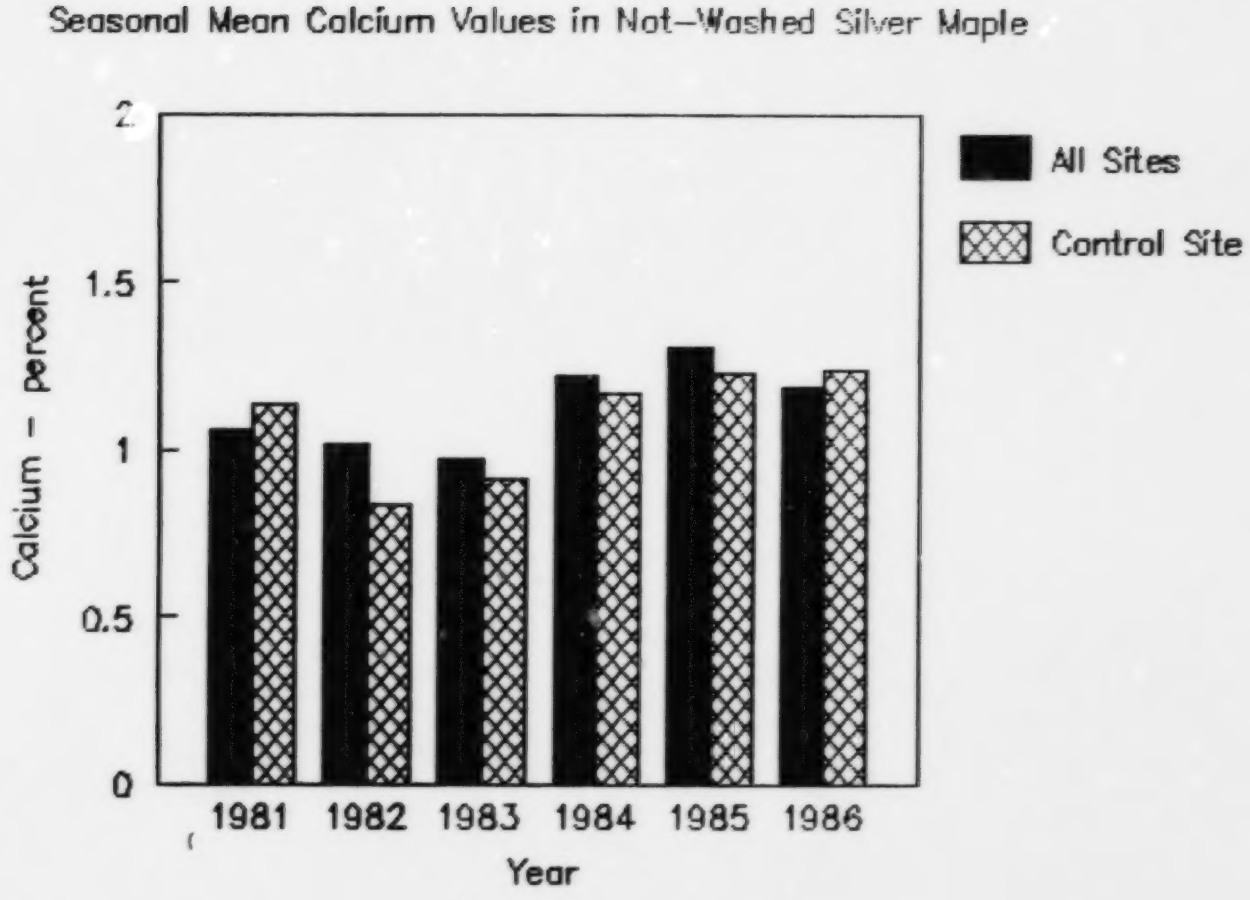
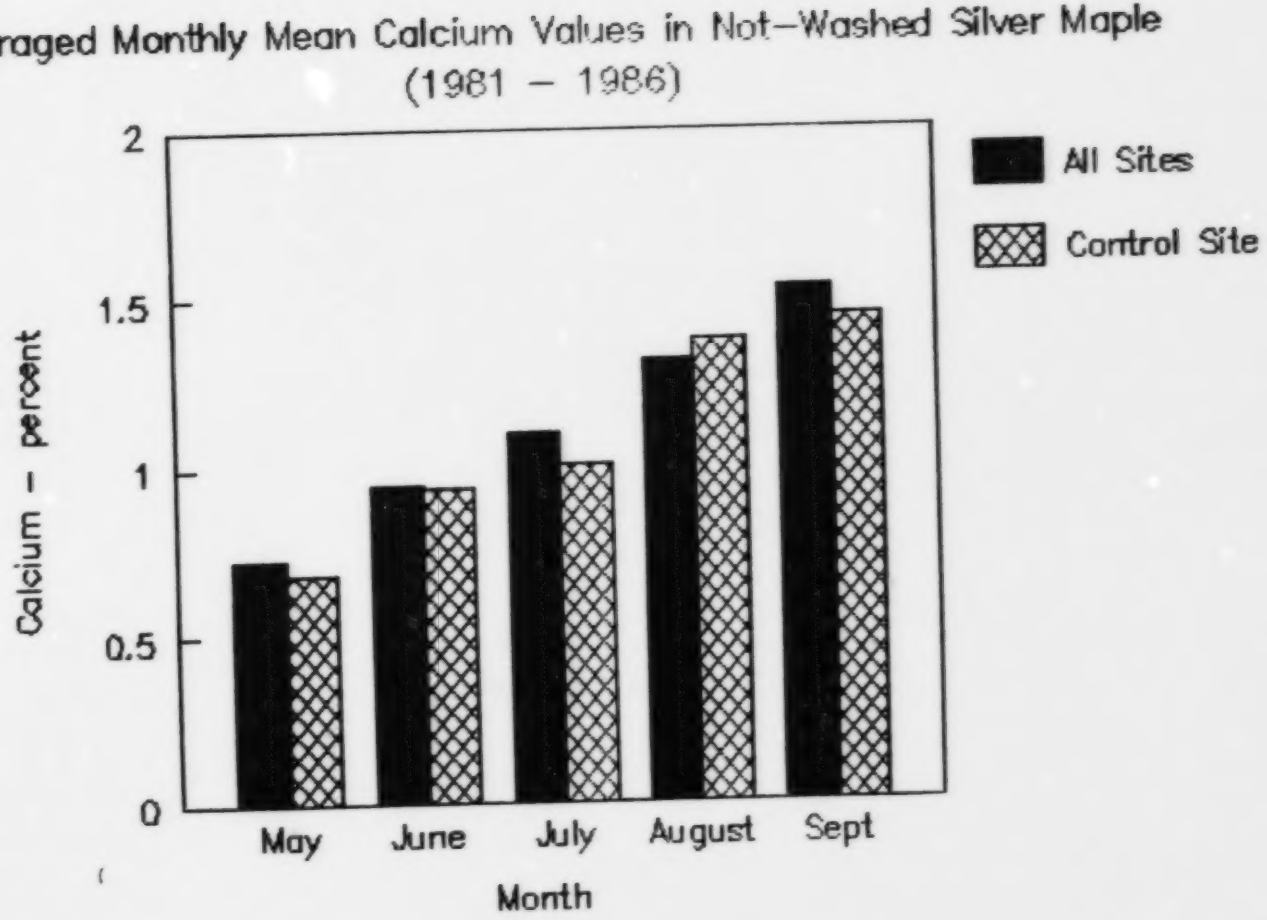

Seasonal Mean Calcium Values in Not-Washed Silver Maple
Calcium - percent
2
1.5
1
0.5
0
1981
1982
1983
1984
1985
1986
Year
All Sites
Control Site

FIGURE: 7


Averaged Monthly Mean Calcium Values in Not-Washed Silver Maple
(1981 - 1986)
All Sites
Control Site
Calcium - percent
2
1.5
1
0.5
0
May
June
July
August
Sept
Month